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COMPARED WITH SIGHTED CHILDREN

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THE MAZE-LEARNING ABILITY OF BLIND COMPARED WITH SIGHTED CHILDREN*

From the Psychological Laboratories of Stanford University

JOSEPHINE R. KNOTTS AND W. R. MILES

INTRODUCTION

Francis Huber, the blind naturalist, whose scientific experiments in reference to the ways of bees are now classic, once spoke of his own writings and observations in the following words (1), "I am much more certain of what I declare to the world than you are, for you publish what your own eyes only have seen, while I take the mean among many witnesses." There are three accepted notions in reference to the relative sensitivity of blind as compared with sighted individuals, which fact probably shows that up to the present we have not consulted enough witnesses nor put the question to them in just the right way. Some have claimed that blindness wrought a compensation and therefore greater acuity of the other senses, particularly of the tactual and kinaesthetic modalities. Again, blind and sighted have been considered of equal sensitivity and, finally, some have held that with the loss of sight the other senses are often in themselves impoverished.

It is easy to see how popular opinion might take the first point of view. Most people pay but little attention to the blind except on occasions to note some special performance of a blind person highly trained in some particular. It seems indeed remarkable for such a person to identify accurately freshly laundered linen, do delicate weaving, or read rapidly aloud from passing the fingers lightly over raised type. Making capital of adversity, there have been not a few buoyant spirits who have positively proclaimed blindness as a help in their chosen profession, e.g., in music or literary authorship. Artman and Hall (both blind) in the challenging preface of their interesting collection state that they believe blindness "rather an advantage than an inconvenience in the art of composition." Current magazines frequently cite similar interviews. The reported account

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of the musician, Blind Boone, is typical. He (2) "did not consider his blindness an affliction but rather a blessing. He believed that he owed his genius to it. . . . at the age of six he lost his sight; but by some apparently miraculous act of compensation his other faculties became proportionately sharpened." On the other hand, Javal, the famous Parisian ophthalmologist, who himself became blind at the age of 62, could not accept this theory of compensation. Concerning touch he wrote (3), "It is possible to increase by training, not its sensitiveness, but its usefulness." Similarly Helen Keller (4) brands this popular opinion as a "fiction which has its origin in ignorance," and Harry Best (5) says, "The remaining senses of the blind receive no added gifts, and take on no new faculties. What they have is simply an acquired ability to use with the utmost effect what is left to them."

Some who have had considerable experience in working with the blind accept the less hopeful of the three points of view. Thus French (6) says, "The educator of the future will count not upon greater sensitivity in his charges but on lessened acuteness as well as the impoverishment of sense impressions as a whole." Work in the cutaneous field, as that on the two-point threshold, done in America and elsewhere has supported all three points of view. So at present we seem forced to take the mean of assuming that the blind and the sighted do not differ in sensitivity in those perceptions which are independent of vision.

The Maze and the Blind

For several years mazes of various sorts have been used with animals and humans, and many comparisons of learning made. It is a little surprising that the maze has not suggested itself as a very suitable instrument for work with the blind, for the comparison between blind and sighted in maze performance is surely a direct and justifiable one.[1] The maze involves both tactual and kinaesthetic

[1]In a private communication from Professor Samuel P. Hayes, dated April 3, 1928, he makes the following comment: "I am much interested to hear that you are using maze tests with blind subjects in the Berkeley School for the Blind. I tried to get some work of this sort started when I began my work at the Philadelphia School for the Blind, ten years ago, but we never got further than some preliminary tryouts with finger mazes that I made on the model of Hampton Court, and one or two others. I made a search thru the literature at that time and found nothing. I have just looked again thru my quite extensive bibliography on the blind and have nothing to offer you except the brief reference by Carr, *Journal of Experimental Psychology*, **4**, p. 399, where he quotes some of Miss Koch's cases."

impressions in a practical and not too artificial manner so that it is not difficult to provide for blind as well as sighted subjects. It may well be that isolated blind people have tried their fortunes in amusement mazes such as Hampton Court, and perhaps in comparison with a blindfolded friend, but so far as we are aware there is no published account of such trials. Koch quoted by Carr (7) seems to have been the first to use blind subjects. In 1921 she reported on three subjects who tried a stylus maze. Their results suggested that the blind are greatly inferior in maze-learning ability. Koch and Ufkess (8) followed up the lead and worked with 19 subjects from the Texas School for the Blind at Austin. These subjects represented an age range from 14 to 26 years and were compared with 20 normal high-school seniors and university students, who in age and intelligence were matched against the blind group. The procedure was similar to that of Koch's earlier experiment (9) and was the same for blind and seeing subjects. The canopy or screening of the maze was used in place of a blindfold, and the directions were given verbally to each group. Koch and Ufkess concluded that the blind tend to be less successful on the average than do the sighted, that having had some visual experience at some time in life reduces the handicap, and that the intelligence of the observer determines in part the ease of maze mastery. They found that errors as a measure differentiated the groups better than did trials or total learning time. If we require a ratio of 3 between the mean difference and the standard deviation of difference, their group differences are not reliable. However, their results are important and, so far as they go, tend to confirm Carr and French cited above.[2]

As has been the common practice in maze work with humans, Koch and Ufkess used a stylus maze. The question may be raised whether this provides a comparable situation for blind and sighted. Tracing a pattern with a stylus is extended touch—the use of a pen or pencil is indeed a very common activity for children with unimpaired vision. The blind have relatively little pencil experience.

[2]We may report that further maze work on the blind has been undertaken by Dr. Helen L. Koch of the University of Texas. A study employing the high relief maze in a different pattern from that which we are here reporting is now in progress under her direction. Dr. Koch reports under date of January 1, 1928, "The high relief maze is mastered with much less difficulty than is the stylus maze, and we are getting interesting data on the relation between the amount of visual experience and success in diagraming."

In the nature of the case the pencil requires some visual guidance. It is common practice to use the typewriter by the touch system, and vision may be constantly directed on the material to be copied, but there is no general tendency to follow this method when engaged in either shorthand or longhand writing. Although the blind are taught to use a pencil, for them it is an unnatural tool. The usual stylus which they employ in their Braille writing frame is really a kind of punch; it is provided with a knob and is grasped in a different manner from that of the finger manipulation of a pen or pencil. For the seeing, the pencil situation is one which could hardly be dispensed with, while the blind under the more or less similar circumstance make constant use of direct contact with the finger. The sighted very commonly supplement their visual impressions by touch, but the totally blind must apprehend their whole world of space and form through tactual and kinaesthetic experience. Every seeing person realizes how immediately he relies on any available touch and auditory cues for guiding himself as soon as he enters a dark room. Thus, theoretically it would seem that to learn a pattern by direct contact with the finger would be a more comparable experience for the blind and sighted than to make contact through a pencil or stylus.

That the high relief maze is more easily mastered than a stylus maze of the same pattern was clearly indicated in the results obtained by Husband (10) and has been definitely proved in the data of Nyswander (11). It was found that 22 college students learning a certain stylus maze required an average of 26 trials, 186 errors, and 37 minutes total time, as compared with results for 66 fellow-students working on an exactly comparable high relief form of the same pattern, who required 18 trials, 83 errors, and 23 minutes to reach the same criterion of learning. These results prove that the experience of direct contact of the finger tip with the maze path results in a more rapid and exact comprehension of the details of the path.

In our study two mazes were employed. Both were of the Warden pattern II (12) which is of T-form, and every unit of true path is balanced by a similar blind alley. (See Figure 4.) Each maze was mounted on a ⅜ inch wooden panel 18″ x 18″. Our method of constructing stylus mazes has been described (13). Figure 1 in our former article illustrates the two mazes used in the present study. A sheet of tin about 17″ x 17″ is tacked lightly to the panel; a sheet of paper ruled in ¼ inch is attached to the tin, and the

diagram of the maze is laid out on the paper (path width ¼ inch). Small blocks of wood ⅜ inch thick are then nailed on, to block in the diagram. The nails pass through the paper and the tin into the

TABLE 1

THE FORTY BLIND SUBJECTS ARRANGED IN TWO SUB-GROUPS, EACH ACCORDING TO DEGREE AND DURATION OF BLINDNESS

Subject	Degree of Blindness	Duration
		Since
8	Total	Birth
15	Total	Birth
2	Bright Colors	Birth
12	Colors, large objects	Birth
19	Light, shadows	6th week
7	Colors, shadows	4th or 5th year
1	Partial	Birth
3	Partial	Birth
6	Partial R., slight L.	Birth
10	Total R., partial L.	Birth
16	Partial	Birth
5	Partial, reads with glasses	Birth
9	Objects, reads with glasses	Birth
14	Light	7th year
17	Total, light	7th-11th years
11	Light	9th year
18	Total R., light L.	R.6th,L.11th
20	Total, no light	13th year
13	Light, shadows	16th year
4	Small print held close	8th year
t	Total	9th month
o	Total	3½ year
f	Light and dark	4th year
h	Colors, shadows	Birth
r	Objects	Birth
b	Counts fingers	Birth
m	R. artificial, L. partial	Birth
a	R. artificial, L. partial	Birth
g	Distinguishes people	Birth
q	Glasses, reads large print	Birth
e	Glasses, reads small print	Birth
j	Total	5th year
k	Light	5th year
d	Shadows	5th year
l	R. artificial, L. partial	R.4th, L.6th or 7th
p	Shadows	10th year
c	Light, large objects	10th year
n	Total	R.13th, L.9th-12th
i	Total	15th year
s	R. artificial, L. bright light	15th year

panel, and, when the blocks are all on, the visible paper is cut away. As the blocks are cut square, the resulting path is regular with smooth edges and square corners and has the smooth tin at the bottom of the groove. The high relief maze as described by Miles (14) is made in much the same way but without the tin, and wire staples are used in place of blocks. The path is not "fenced in" but is constituted of a single row of staples, on top of which the subject's finger passes. In both mazes the numbering of the parts of the path, on the maze panel or on the blocks, facilitated *E*'s recording of the errors.

A blindfold of standard type (14), consisting of leather goggles with adhesive tape covering the glasses and tissue paper inserted between *O*'s face and the goggles, was worn by each and every subject, sighted and blind. To some of the latter, the blindfold was naturally a source of slight amusement.

A total of 40 blind subjects, 16 girls and 24 boys from the California School for the Blind, Berkeley, served in the experiment.[3] The degree of blindness varied from total lack of vision since birth to a deficiency since the eighth year that permitted reading print held very close. The varying degrees of sight are indicated briefly in Table 1. The sighted subjects were secured from the Palo Alto High School and were paired with the blind in sex, age, and I.Q. (see Table 2). Blind and sighted groups were each divided into two sub-groups of approximately parallel chronological and mental ages. The stylus maze was given to one pair of these sub-groups (20 blind and 20 sighted) and the high relief maze to the others.

Ordinarily the students did the experiments during regular study periods, though in a few cases they were excused from classes. The schedules of the two schools necessitated slightly different procedures. The program at Berkeley was based on 60-minute periods, that at Palo Alto on 40-minute periods. Subjects who required more than 40 minutes to learn the maze had a different practice distribution. Occasionally a subject was excused from class to continue the experiment, but usually, if a subject required more than one period to

[3]We acknowledge our indebtedness to Dr. R. S. French, Principal, Dr. Anita M. Muhl, Miss Doris M. Thorneley, and other officers and teachers of the California School for the Blind; also we would express our thanks to Mr. W. H. Nichols, Principal, Mrs. L. H. McCully, Vocational Director, Mrs. G. E. Stewart, Registrar and teacher in the Palo Alto High School. The services of both the blind and sighted pupils are acknowledged with gratitude.

TABLE 2

THE BLIND AND SIGHTED SUBJECTS PAIRED ACCORDING TO SEX, CHRONOLOGICAL AGE, AND INTELLIGENCE QUOTIENT[4]

Subject[5]	Sex	Blind Subjects		Sighted Subjects	
		Birth date[6]	I.Q.	Birth date[7]	I.Q.
1	F	July 17, 1911	110	Sept. 19, 1911	111
2	F	Feb. 16, 1909	103	Oct. 9, 1909	105
3	F	Jan. 31, 1908	94	Dec. 15, 1908	94
4	F	July 26, 1911	97	May 15, 1911	97
5	F	June 28, 1910	106	Sept. 5, 1910	105
6	F	Feb. 13, 1916	124	Apr. 16, 1916	124
7	F	Nov. 5, 1910	107	Apr. 7, 1910	107
8	F	Sept. 27, 1910	97	Nov. 12, 1910	98
9	M	July 28, 1909	115	Sept. 2, 1909	116
10	M	June 2, 1913	101	July 20, 1913	100
11	M	Nov. 19, 1914	103	Feb. 3, 1914	103
12	M	Aug. 15, 1910	109	Dec. 17, 1910	110
13	M	Oct. 26, 1908	90	Aug. 20, 1908	90
14	M	Feb. 22, 1913	107	Apr. 20, 1913	107
15	M	Apr. 16, 1915	129	Sept. 22, 1915	107
16	M	Aug. 21, 1915	134	Dec. 7, 1914	138
17	M	Aug. 3, 1906	101	Apr. 25, 1908	101
18	M	Jan. 17, 1911	105	Nov. 25, 1911	104
19	M	Apr. 12, 1909	107	Apr. 15, 1909	107
20	M	May 16, 1906	98	July 27, 1907	96
a	F	April 1913	97	Mar. 26, 1913	98
b	F	Sept. 23, 1910	103	Aug. 1, 1910	103
c	F	Dec. 25, 1908	96	June 29, 1909	95
d	F	May 3, 1909	98	Dec. 4, 1909	98
e	F	Apr. 19, 1908	100	May 21, 1908	100
f	F	Feb. 17, 1909	106	Oct. 30, 1909	105
g	F	Aug. 13, 1909	92	Jan. 10, 1909	93
h	F	Mar. 5, 1911	113	Apr. 26, 1911	113
i	M	May 1, 1909	115	Dec. 21, 1909	114
j	M	Jan. 10, 1910	92	Aug. 14, 1910	94
k	M	Mar. 1, 1911	107	May 25, 1911	108
l	M	Aug. 9, 1914	111	Feb. 3, 1914	112
m	M	Feb. 1, 1913	91	Feb. 6, 1913	92
n	M	Nov. 7, 1910	105	Oct. 16, 1910	105
o	M	Aug. 24, 1917	161	Sept. 23, 1918	162
p	M	Feb. 23, 1914	124	Jan. 21, 1914	126
q	M	Jan. 30, 1911	98	June 27, 1911	96
r	M	Mar. 30, 1912	106	Feb. 11, 1912	107
s	M	Feb. 16, 1909	105	May 15, 1909	107
t	M	Mar. 27, 1907	102	Sept. 24, 1907	105

[4]The I.Q.'s were taken from the school records. The blind subjects had been tested with the Stanford-Binet within three months previous to the experiment. Each Palo Alto High School student is scored on a Stanford Group Test upon entering the school. The remaining two subjects had been given the Stanford-Binet by the Stanford University Psychology Department within the previous year.

[5]The numbered subjects learned the stylus maze, the lettered ones had the high relief maze.

[6]The maze observations on the blind were made at Berkeley in February and March, 1928.

[7]The sighted subjects were used at the Palo Alto High School in April, 1928.

master the maze, the trials were continued the following school day. In rare cases this meant a delay from Friday to Monday.

The procedure was as follows. *O* was seated in a chair of comfortable height at the corner of a desk or table, on which lay the maze covered by heavy paper. *E* sat at *O*'s left and facing him. The blindfold was put in place and tested. For the blind the reason given for covering the eyes was "in order that all the blind may do the test entirely without vision," while the sighted were told, "in order that you may be compared with the blind." The cover was then removed from the maze. When using the stylus maze *E* read the following explanations and instructions.

"You are now going to learn a pattern by passing a pencil through a grooved pathway. During the whole of the experiment you are to keep the hand you are not using on the corner of the board. Take the pencil in the hand with which you write, holding it straight [perpendicular] and up high enough not to touch the pattern with your hand. [*E* places the pencil in *O*'s hand and guides it through the sample grooves.] We are now going to try a sample pattern. It is made exactly the same way as the pattern which you are to learn. The grooves are the same width and depth. Here you come to a place where you may go in either direction. [*E* oscillates the pencil back and forth, finally leading off into the blind alley.] It is for you to choose in which direction you go. I am going to take you in this direction. Here you are stopped. You cannot go in any direction, other than back. This is a blind alley. You want to avoid going into blind alleys, but if you are in one, you must go back and take the direction which you might have chosen. Here your pencil is free. That means you have come to the end of the pathway. In the pattern which you are going to learn you will not come to the end so soon, but, if you make a correct choice of direction, you will continue on the path rather than be stopped by a blind alley. The goal of the experiment is to be able to go through the pattern from the beginning to the end without going into any blind alleys. When you have made three perfect trials together, we consider that you have learned the pattern. Although I am going to keep track of the amount of time it takes you to go through the pattern, it is somewhat more important that you be accurate than that you hurry."

The instructions for the high relief maze were essentially the same.

"You are now going to learn a pattern by running your finger over a raised pathway. [*E* takes *O*'s hand, flexed so that the index finger is extended, free, and places the finger tip on the sample pattern.] We are now going to try a sample pattern. This single hump is the starting-point. Our sample pattern is made exactly the same way as the pattern which you

are to learn, etc., etc. Here the path ends. This is a blind alley, etc. Here is a double hump. That means that you have come to the finish of the pathway. . . . . ."

Each maze had 10 choices in it and, of course, as many blinds. Trials were repeated one after the other until the pattern was learned. During each trial *E* recorded the alleys entered and at the end, from a stop-watch, noted the time. It was not recorded an error if, after entering an alley, a subject returned to the true path before coming to the end of the alley. If *O* started retracing after having gone into a blind alley, *E* said, "You are going back," and blocked his pathway so that he could not go farther back. If the pencil was held at an angle which caused *O* to interpret wrongly, he was reminded to keep the pencil perpendicular. There were no other instructions. When *O* had completed the experiment, he was asked to describe the method he had used in learning the pattern.

Results

The data, treated with those statistical methods which are feasible in results from groups of less than 25 cases, are presented in the following tables. Central tendencies and variabilities are given together with correlations computed by the product-moment formula. When the groups number only 20, there is no justification in trying to state the reliability of differences. We could have used the entire 40 blind on one maze for comparison with the entire group of sighted on the same maze, but it seemed a wiser experimental procedure to employ the maze pattern in the two forms.

The matching of subjects, so far as we at present have available means, that is, in sex, age, and I.Q., was undertaken very seriously, as we believe is sufficiently indicated by Table 2. Naturally, as in such experiments, the blind were used first, and then sighted children were chosen to match the blind. For the high relief maze the mean C.A. was 206 months for both B and S, and the mean M.A. was 194 months for B and 195 for S. The pairs of subjects in C.A. correlated .99±.01 and in M.A., .94±.02. With the stylus maze, the mean C.A. was 204 for B and 203 for S, while the mean M.A. was 194 for B. and 195 for S., just as above. Here the correlation for the subject pairs was .98±.01 for C.A. and .94±.02 for M.A. So far as such criteria go, the matching was perfectly satisfactory.

With reference to the two groups of blind, the mean C.A. of

those tried with the high relief or finger maze was two months greater than for those on the stylus maze, but in mental age they had the same average of 194 months. The two groups of sighted show mean C.A. for finger maze of 206 and for stylus maze 203, with the mean M.A. for both at 195. Therefore, so far as the matching of sub-groups is concerned, we have every reason to expect directly comparable results on the two mazes, and in the discussions of the results it will not be necessary to bear in mind differences in chronological and mental age.

The complete results, that is, the number of trials to learn (which includes the three perfect consecutive trials to meet the adopted criterion of learning), the total number of errors made, the total time consumed by the task, and the average time per trial are given for each individual subject. The data for the high relief maze are presented in Table 3, while a similar arrangement, Table 4, shows the data for the comparable stylus maze. On the high relief maze the most successful blind subject, B*p*, shows 11 trials, 8 errors, 234 seconds, and an average time per trial of 21 seconds. Among the sighted the best are S*s* with 10 trials, 22 errors, 579 seconds, and an average of 58 seconds, and S*b* with 16 trials, 22 errors, 471 seconds, and an average of 29 seconds. Husband (10), when using this identical maze with 20 university students as subjects, found that the trials to learn ranged from 5 to 31 and averaged only 16.7. So the best performances found for our blind and sighted subjects are really not very remarkable. However, some of the poorest performances are indeed remarkable. Table 3 shows that there were three blind, B*a*, B*d*, and B*m*, (none of them totally blind) who required 125 or more trials to learn. None of the sighted was quite as poor as these three, but here also there are conspicuously slow subjects, S*o*, S*j*, S*f*, and S*k*, all of whom required 65 or more trials.

For the high relief maze, the blind have somewhat greater range in individual results than have the sighted. Except for one subject, S 16, the same statement is true for the stylus maze. The blind include three, B 18, B 14, and B 9, who required 18 to 19 trials and made only 43 to 51 errors. But at the other end there are four blind subjects, B 2, B 5, B 13, and B 17, who required approximately 200 trials and made from 325 to 688 total errors. On the stylus maze, the sighted show no one as good as the three mentioned of the blind. The best is S 18 with 21 trials and 56 errors, and the

TABLE 3

RESULTS ON THE HIGH RELIEF MAZE FOR BLIND AND SIGHTED SUBJECTS

Subject	C.A. (months)	M.A.	Trials	Errors	Time (sec.)	Av. Time Each trial
Blind						
a	179	174	163	489	4643	29
b	209	198	34	84	952	28
c	230	184	36	149	897	25
d	228	188	125	333	4280	34
e	239	192	32	57	1216	38
f	228	203	70	175	2186	31
g	223	177	35	76	1241	35
h	204	217	30	78	996	33
i	226	221	27	72	929	34
j	217	177	43	98	960	22
k	204	205	29	54	797	27
l	163	181	27	61	661	24
m	181	165	156	537	2963	19
n	208	202	14	24	361	26
o	127	204	25	72	747	30
p	168	208	11	8	234	21
q	205	188	45	113	1787	40
r	191	202	21	44	1526	73
s	228	202	21	45	864	41
t	251	202	44	137	1344	30
Mdn.	208	200	33	77	978	30
Q.Dev.	21	10	9	44	413	4
Mean	206	194	49	135	1479	32
S.Dev.	29	14	44	143	1163	11
Sighted						
a	181	177	35	106	953	27
b	212	198	16	22	471	29
c	226	182	37	72	980	26
d	220	188	35	104	1554	44
e	239	192	43	93	1378	32
f	222	202	68	185	2532	37
g	231	179	43	108	1066	25
h	204	217	32	77	1097	34
i	221	219	15	32	306	20
j	212	180	69	172	1871	27
k	203	207	65	100	1706	26
l	170	190	31	94	1047	34
m	182	167	34	83	1134	33
n	210	202	20	60	783	39
o	116	188	88	315	4804	55
p	171	215	21	59	662	31
q	202	184	35	87	1210	35
r	194	205	40	94	1138	28
s	228	205	10	22	579	58
t	247	202	15	36	481	32
Mdn.	211	196	35	90	1081	32
Q.Dev.	18	11	11	23	372	4
Mean	206	195	38	96	1288	34
S.Dev.	29	14	20	65	807	9

TABLE 4

RESULTS ON THE STYLUS MAZE FOR BLIND AND SIGHTED SUBJECTS

Subject	C.A. (months)	M.A.	Trials	Errors	Time (sec.)	Av. Time Each trial
Blind						
1	199	211	38	80	1709	45
2	228	198	260	688	6071	23
3	241	180	41	143	1069	26
4	199	186	24	59	571	24
5	212	203	198	325	3907	20
6	145	180	71	186	1218	17
7	208	205	38	130	1474	39
8	209	186	139	482	3648	26
9	222	221	19	51	694	36
10	177	179	54	146	1398	26
11	159	164	51	160	1140	22
12	210	209	90	210	1588	18
13	232	173	197	446	2797	14
14	180	193	18	53	913	51
15	155	200	70	264	2004	29
16	151	202	59	177	1667	28
17	259	194	197	387	5127	26
18	207	202	18	43	388	22
19	227	205	66	160	2138	32
20	262	188	38	125	1209	32
Mdn.	208	196	56	160	1531	26
Q.Dev.	24	10	38	96	681	5
Mean	204	194	84	216	2036	28
S.Dev.	33	14	71	166	1495	9
Sighted						
1	199	213	31	84	1100	35
2	223	202	120	328	2915	24
3	232	180	102	273	2045	20
4	203	186	82	224	2040	25
5	211	202	87	281	2205	25
6	144	179	209	473	4863	23
7	216	205	49	88	1845	38
8	209	188	70	160	1470	21
9	223	223	91	206	1763	19
10	177	177	39	90	1179	30
11	170	175	109	332	3616	33
12	209	211	71	205	1419	20
13	236	173	37	82	832	22
14	180	193	173	529	3040	18
15	151	192	43	127	1571	36
16	161	222	300*	1107*	6530*	22
17	240	194	26	63	868	33
18	197	200	21	56	732	35
19	228	205	30	67	910	30
20	249	184	105	334	2977	28
Mdn.	209	193	76	205	1804	25
Q.Dev.	23	11	34	122	903	6
Mean	203	195	79	211	1968	27
S.Dev.	29	15	49	138	1604	6

*Not included in the computation of mean and standard deviation.

next is S 17 with 26 trials and 63 errors. At the other end of the scale, aside from S 16, who made 300 trials and still did not learn the pattern, the sighted show S 6 with 209 trials and S 14 with 173. Although blind and sighted have been closely matched for chronological age and mental age, when it comes to the maze tasks it is found that among the blind there are some who find these special problems easier than the sighted, and there are also some who find them harder than do the sighted. There is the one exception of the sighted subject who was unable to learn the problem, and this individual had an I.Q. of 138.

It is important to notice that in the nature of things no one can do the maze experiment with less than about a certain number of trials and errors, while at the other end of the range the task offers the chance of multiplying trials and errors almost endlessly. This being the case, the group of subjects showing the wider range will almost certainly show the larger mean. It is obvious that the median is fairer as a basis of comparison where there are marked range differences, and therefore we shall confine our discussion to the medians found for the various groups. The averages or means together with the standard deviations are also shown in the tables.

With the high relief maze, which provided direct finger contact with the path, the median values for the group of 20 blind are 33 trials, 77 errors, 978 seconds, and 30 seconds per trial. The comparable values for the group of 20 sighted are 35 trials, 90 errors, 1081 seconds, and 32 seconds. The blind, therefore, show as good or better performance in all scores measured: two trials less to learn, 13 errors less in the total errors made, which is about 15 per cent less errors than the sighted, 10 per cent less total time for the task, and two seconds less per trial. The ratio of trials to errors is 1:2.33 for the blind and 1:2.57 for the sighted. But the blind showed a higher incidence of subjects who found the task particularly difficult.

We turn now to the median results on the stylus maze, which, as explained above, were secured on another group of 20 blind matched with another group of 20 sighted subjects. The medians for the blind are: 56 trials, 160 errors, 1531 seconds total time, and 26 seconds per trial. The comparable medians for the sighted are: 76 trials, 205 errors, 1804 seconds total time, and 25 seconds per trial. Again the blind give as good or better scores. The blind show 20 trials less than the sighted, which amounts to 26 per cent. There is a difference of 45 errors, which equals 22 per cent. The

blind required less total time by 273 seconds, which is 15 per cent, but both groups worked at about the same rate per trial and this latter was the case also with the high relief maze. The ratio of trials to errors for the blind was 1:2.86, while for the sighted it was 1:2.70. In this measure of the number of errors per trial, the sighted do slightly better than the blind with the stylus maze, and they are also a little faster per trial than the blind.

For both blind and sighted, when the finger is in direct contact with the maze path, the rate of movement is slower than when the stylus is used; the results in Tables 3 and 4 show about 31 seconds in comparison to an average of 25.5 seconds per trial. These values should, of course, be corrected in the light of the usual number of errors made per trial. One unit of true path on either maze measures 3 inches in total length, and a blind measures the same distance. Counting the starting section, the total true path was 33 inches in length. A blind, of course, adds double its length or 6 inches to the distance travelled. On the finger maze the ordinary number of errors made by all subjects was 2.45 per trial, which would add 14.7 inches or make an ordinary distance of 47.7 inches for the path traversed. On the stylus maze, the combined groups show 2.78 errors per trial or 16.7 inches, making a total of 49.7 inches as the usual distance travelled. Therefore, with the high relief maze we find a rate of movement of one inch in 0.65 seconds, and on the stylus maze the rate is one inch in 0.51 seconds. The direct finger contact is thus somewhat more than 20 per cent the slower. This difference is in large part due to the fact that the grooves guide the stylus which may thus be pushed rapidly between choice points. Some care must be exerted to keep the finger on the path, and with the finger touching, particularly at the choice points, there is a wider spread of contact experience, cutaneous in character, as compared with the kinaesthetic limited experience obtained from the use of the stylus.

Learning Curves

A learning curve (see Figure 1) constructed from the average number of errors summed by groups of five trials illustrates the progress of mastering the two mazes. In the initial five trials both mazes seem to be about equally difficult for the four subject groups. Beyond this point, that is, in trials 6 to 10 inclusive, the errors on the finger maze are consistently less than those on the stylus maze. It is also noteworthy that at this point on the stylus maze the sighted

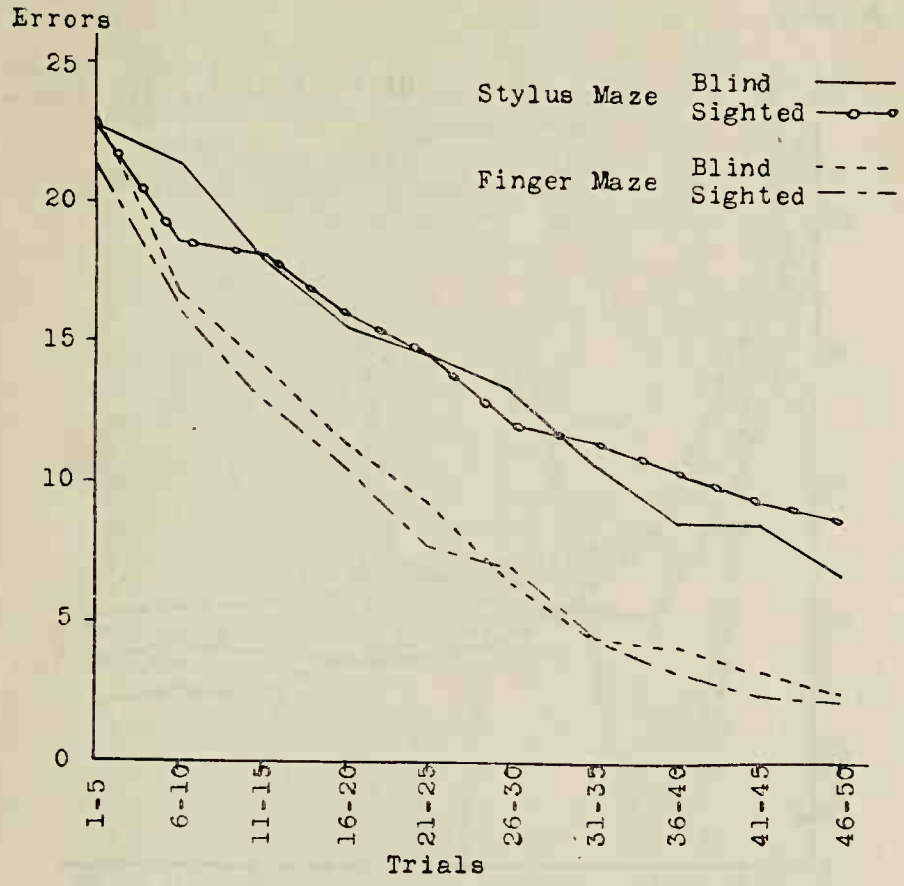

FIGURE 1

AVERAGE NUMBER OF ERRORS SUMMED BY GROUPS OF FIVE TRIALS FOR BLIND AND SIGHTED ON STYLUS AND FINGER MAZES

show up considerably better than the blind. The errors on the high relief maze decrease more rapidly than those on the stylus maze. The pairs of curves for blind and sighted run closely parallel courses. During the first 25 trials on the finger maze, the sighted (here in terms of averages) do consistently a little better than the blind. All in all, the rate of learning for the two groups with the two maze tasks gives curves of the same character. This statement is confirmed by Figure 2, which also shows the average time required for the first ten trials by the blind and sighted on both mazes. During the first three trials on the stylus maze, the sighted require more time to go through than do the blind. After the third trial the

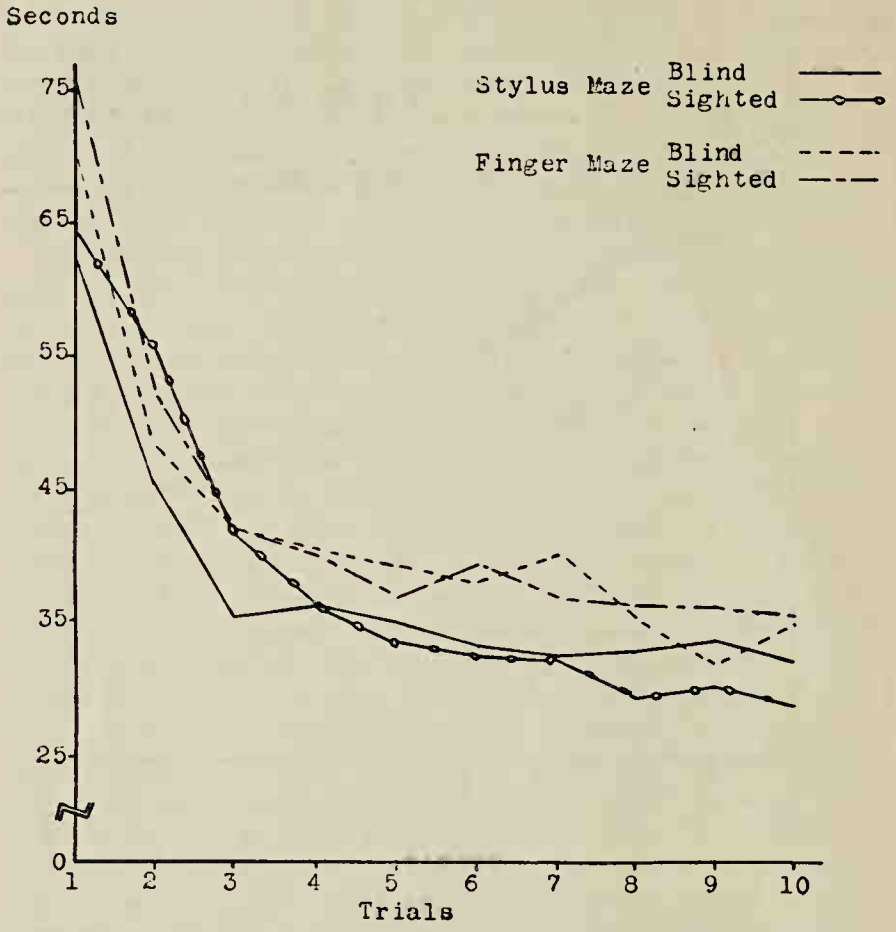

FIGURE 2

AVERAGE TIME REQUIRED FOR FIRST TEN TRIALS BY BLIND AND SIGHTED ON STYLUS AND FINGER MAZES

curves reach a level closely the same for both groups. By this time a rate of travel in the maze has been adopted which decreases but slowly as the trials succeed each other. The curves for the finger maze tend to show slower progress from the first.

ANALYSIS OF DIFFICULTIES

The average number of entrances into each alley is charted in Figure 3. Both blind and sighted agree very well and show for both mazes that alleys 7, 11, and 17 are particularly difficult, while 3, 9, and 19 are relatively easy. The arrangement of the errors

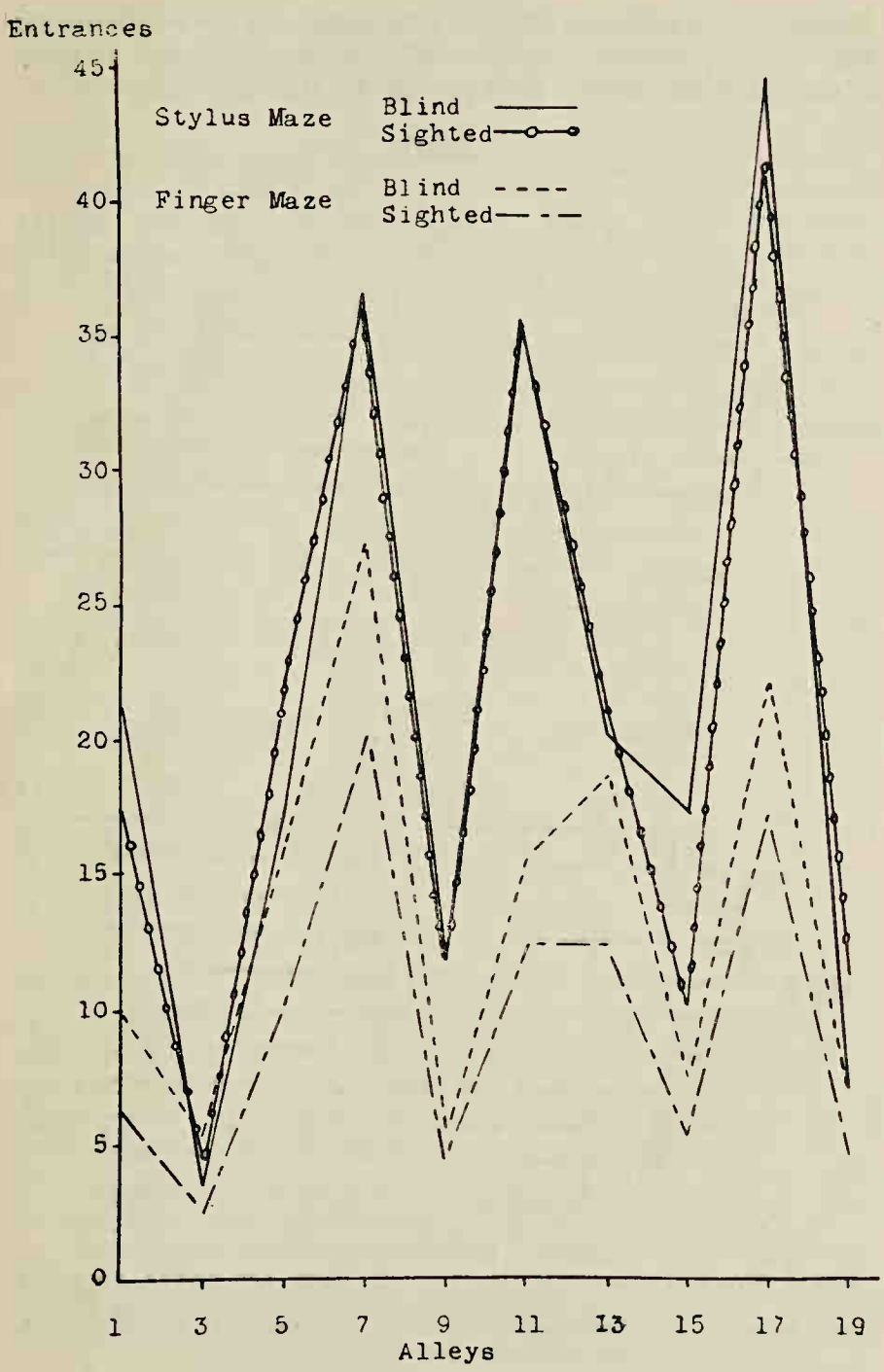

FIGURE 3

AVERAGE NUMBER OF ENTRANCES INTO EACH ALLEY BY BLIND AND SIGHTED SUBJECTS WHO LEARNED THE STYLUS OR FINGER MAZE

indicates the pronounced tendency to respond in terms of alternating right and left choices. The effect of sequences in this type of maze is strong; it has already been noticed by Husband (10), and we

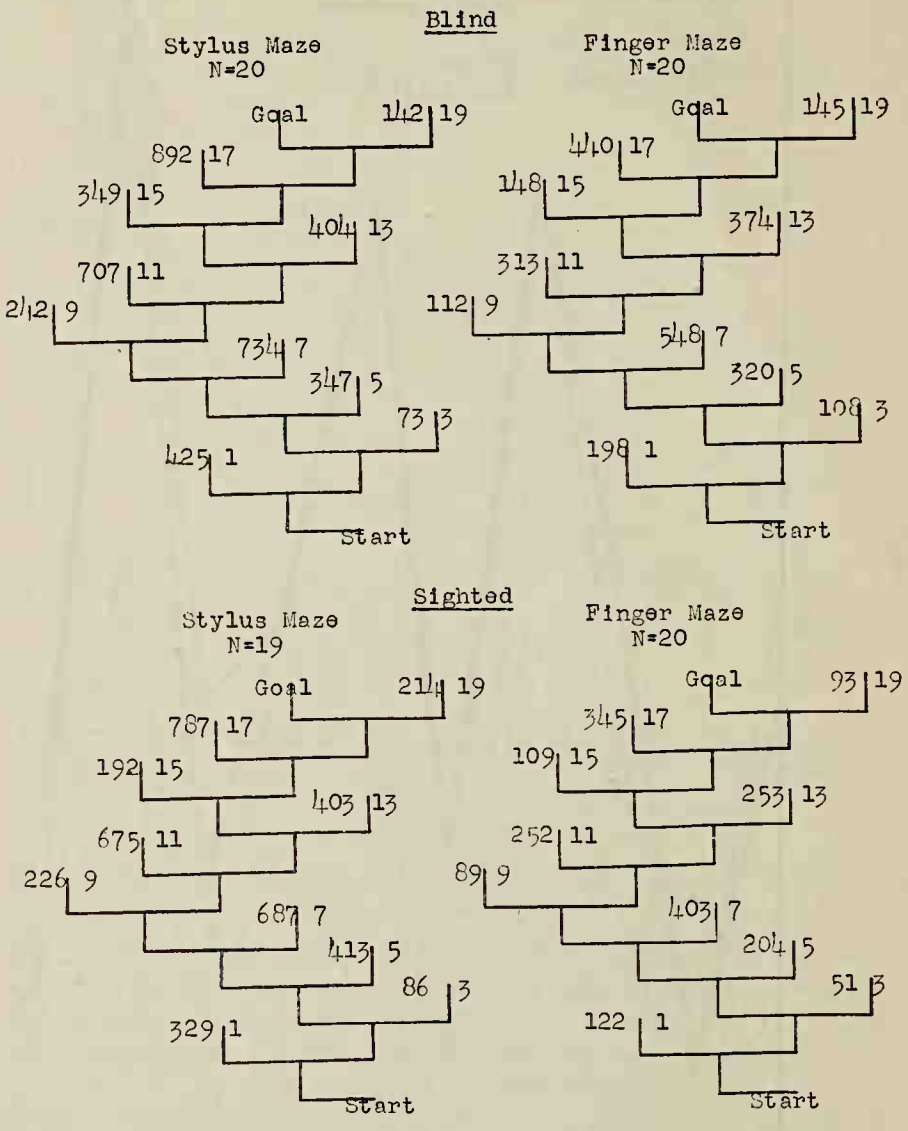

FIGURE 4

THE TOTAL NUMBER OF ENTRANCES INTO EACH CUL-DE-SAC SHOWN IN CONNECTION WITH THE MAZE PATTERNS USED, WHICH ARE AFTER WARDEN
Each cul-de-sac is numbered at the right, and the total errors made by the group are entered at the left.

have placed our own results (see Figure 4) in the form of a chart similar to his. In every case the errors increase progressively from one member of a sequence to the next. For example, alleys 3, 5, 7, are all right turns; the number of entrances by the blind on the stylus maze are respectively 73, 347, and 734. The second member of a sequent pair has about four times the mistakes of the first, and the third member about twice the errors of the second or approximately eight times the errors of the first. This behavior tendency is somewhat less marked with the blind especially on the finger maze.

Intercorrelation of Factors in Maze Learning

The correlations between chronological age, mental age, and the various maze-learning scores have been computed. The coefficients of correlation for the high relief maze are embodied in Table 5,

TABLE 5

Finger Maze Scores Correlated with Chronological Age and with Mental Age

	M.A.	Trials	Errors	Time	Av.Time
		Blind Subjects			
C.A.	.08 ± .15	−.05 ± .15	−.08 ± .15	−.04 ± .15	.13 ± .15
M.A.		−.61 ± .09	−.62 ± .09	−.49 ± .11	.25 ± .14
Trials			.98 ± .01	.93 ± .02	−.21 ± .14
Errors				.88 ± .03	−.24 ± .14
Time					.06 ± .15
		Sighted Subjects			
C.A.	.14 ± .15	−.40 ± .13	−.58 ± .10	−.58 ± .10	−.17 ± .15
M.A.		−.31 ± .14	−.33 ± .13	−.23 ± .14	.00
Trials			.92 ± .02	.89 ± .03	.11 ± .15
Errors				.97 ± .01	.33 ± .13
Time					.46 ± .12

and those for the stylus maze are given in Table 6. The correlations between errors and trials, errors and time, and between trials and time are uniformly high (.88 to .98) and show very small probable errors. The correlations of average time per trial with the other maze-learning scores show negative values ranging from —.25 to —.56 for stylus maze learning. But on the finger maze the coefficients are some negative and some positive, and in all cases, that is, for both mazes, the probable errors are relatively large. The average time per trial as a measure of maze-learning ability thus appears much less reliable than are trials, errors, or total time.

Mental age has a closer relationship with success in maze learning

than has chronological age. In these tables negative coefficients indicate that the older or more intelligent succeeded better. With the finger maze the blind show —.61±.09, —62±.09, and —.49 ±.11 as correlations between mental age and trials, errors, and time, respectively. For the sighted the comparable values are smaller: —.31±.14, —.33±.13, and —.23±.14. Chronological age shows somewhat opposed results; for the blind the values are very small while for the sighted they are larger than this group gave for mental age. Turning to the stylus maze, Table 6, we find that

TABLE 6
STYLUS MAZE SCORES CORRELATED WITH CHRONOLOGICAL AGE AND MENTAL AGE

	M.A.	Trials	Errors	Time	Av.Time
		Blind Subjects			
C.A.	.15 ± .15	.33 ± .13	.25 ± .14	.36 ± .13	.00 ± .00
M.A.		−.10 ± .15	−.17 ± .15	.03 ± .15	.42 ± .12
Trials			.94 ± .02	.94 ± .02	−.48 ± .12
Errors				.91 ± .02	−.45 ± .12
Time					−.25 ± .14
		Sighted Subjects			
C.A.	.06 ± .15	−.35 ± .13	−.30 ± .14	−.42 ± .12	−.10 ± .15
M.A.		−.75 ± .07	−.75 ± .07	−.32 ± .13	−.02 ± .15
Trials			.97 ± .01	.92 ± .02	−.56 ± .10
Errors				.89 ± .03	−.54 ± .11
Time					−.27 ± .14

chronological age gives low coefficients, which curiously are all positive for the blind but negative for the sighted. Mental age shows quite strong correlation (negative) with trials and errors made by the sighted, but for the blind the comparable values are surprisingly small and not larger than their probable errors. In general, mental age correlates with the maze results rather better for the sighted than for the blind groups. The correlation of intelligence and maze scores for human subjects has recently been reviewed by Cox (15). Authors usually state that success in the maze is positively related to intelligence, but the coefficients are seldom over .50.

INFLUENCE OF DEGREE OF BLINDNESS ON NUMBER OF TRIALS

Blindness may arbitrarily be divided into three degrees: (1) no detail vision since the fourth year; (2) partial blindness since birth, including those cases which have sufficient vision to read print held

close with the aid of glasses, when the condition is congenital; (3) blindness as a result of accident or illness since the fifth year.

In learning the stylus pattern, the six totally blind subjects show a mean of 110.5 trials; the seven partially blind subjects, 68.6 trials; and the seven blinded by accident or illness, 82.6 trials. In learning the finger pattern, the six totally blind give a mean of 53.2 trials; the five partially blind, a mean of 86.2 trials; and the nine blinded through accident or illness, 36.4 trials. For the complete results

TABLE 7

INFLUENCE OF DEGREE OF BLINDNESS ON NUMBER OF TRIALS REQUIRED TO LEARN MAZE PATTERN

Degree of blindness[8]	Stylus Maze		Finger Maze	
	Subject	No. of trials	Subject	No. of trials
(1)	8	139	*t*	44
	15	70	*o*	72
	2	260	*f*	70
	12	90	*n*	78
	19	66	*r*	21
	7	38	*b*	34
	Mean	110.5	Mean	53.2
(2)	1	38	*m*	156
	3	41	*a*	163
	6	71	*g*	35
	10	54	*q*	45
	16	59	*e*	32
	5	198		
	9	19		
	Mean	68.6	Mean	86.2
(3)	14	18	*j*	43
	17	197	*k*	29
	11	51	*d*	125
	18	18	*l*	27
	20	38	*p*	11
	13	197	*c*	31
	4	59	*m*	14
			i	27
			s	21
	Mean	82.6	Mean	36.4

[8]The degrees of blindness are classified: (1) no detail vision since the fourth year; (2) partial blindness since birth, including those cases which have sufficient vision to read print held close with aid of glasses, when condition is congenital; (3) blindness as a result of accident or illness since the fifth year. Subjects are arranged within each classification according to degree, those having greatest duration of blindness appearing first.

see Table 7. The estimated medians of the groups indicate the median subject in the group of totally blind to require more trials on both the stylus and high relief patterns than the median subject in

the partially blind group, while the median one of those subjects blinded through accident or illness requires less trials than either of the others.

Blindness group No. 1 includes the most unsuccessful blind subject on the stylus maze, B 2, 260 trials, but the entire table shows that the very poor learners are quite evenly distributed between the three blindness groups. Extremely poor success in the maze learning is therefore not solely contingent on the totality and duration of blindness. On the other hand, the more successful subjects tend to be in blindness group No. 3, that is, blindness as result of accident or illness since the fifth year. Thus it appears just to conclude, as shown above and in confirmation with the results found by Koch and Ufkess (8), that extent and duration of blindness constitute a real factor influencing success with such spatial problems as the maze which is to be traversed by the subject's hand.

Methods of Learning

In recording the method of learning as reported by the individual subjects, four general classifications of verbal, verbal-motor, motor, and visual were used. Subjects often gave rather indefinite or contradictory answers. Blind subject B*g* said, "I tried to remember —first I thought I could do it a general way, then I knew I'd have to remember by the feel." When *E* tried to learn if there was verbalizing connected with the "remembering," the subject answered definitely, "I didn't try to count." This subject was therefore classified as using the motor method. The verbal-motor classification includes those subjects who reported a combination verbal and motor method, and also those who may have given up one of the methods

TABLE 8

The Methods of Learning Compared with the Number of Trials to Learn

	Methods							
	Verbal		Verbal-Motor		Motor		Visual	
	No. of subj.	No. of trials	No. of subj.	No. of trials	No. of subj.	No. of trials	No. of subj.	No. of trials
				Stylus maze				
Blind subjects	10	39	4	110	5	132	1	198
Sighted "	6	51	5	66	5	123	3	81
				Finger maze				
Blind subjects	10	29	3	97	6	71		
Sighted "	9	36	9	39	2	37		

in favor of the other sometime during the consecutive trials. The methods with the results in terms of trials to learn are given in Table 8.

Half the blind subjects use the verbal method. A larger proportion of sighted subjects use the verbal method on the finger pattern than on the stylus pattern. Each of the four groups indicates an economy of the verbal method over the others. As a rule, the motor method requires two or three times as many trials as the verbal.

Discussion of Results

Although the blind and sighted subjects are paired according to age and I.Q., there is no significant correlation between the performances of individuals who make up these pairs, as shown in their scores for number of trials, errors, and total time involved in maze learning. The importance of so pairing the subjects is rather to be judged by correlating the chronological and mental ages directly with the maze-learning scores. Chronological age does not correlate strongly with trials, errors, and time, nor always in the direction which we might expect, with the blind subjects. However, with the sighted subjects it does correlate in the direction expected (older children do better on the tasks), and in the case of the finger maze the values are sufficiently large to be counted significant.

Mental age, in the groups studied, has a larger influence on maze-learning ability than does chronological age. Except in the case of the total time taken by the blind subjects when learning the stylus pattern, there is a consistently negative correlation between mental age and the total trials, total errors, and total time scores. In general, the correlations indicate a significant relation, except for the blind group working with the stylus maze. Our results therefore confirm those secured by Koch and Ufkess (8) and Cox (15) in showing that even in a group of fairly narrow intelligence range the more intelligent subjects have better scores in performance of the maze-learning tasks. Therefore, though there may be low correlation between the results of "matched" subjects after they have been paired, for purposes of experimenting with such a condition as that represented by blindness, mental age is a desirable criterion for the selection of "comparable groups."

It has appeared unjustifiable to us to employ averages as a basis for comparing the blind and sighted groups. We have found that the results for the blind show considerably wider ranges. Therefore the natural values for comparison are the medians. It has

been shown that, for both mazes and for the different maze-learning scores employed, the blind do fully as well or better than the sighted. The differences in favor of the blind are more noticeable on the stylus pattern than on the finger maze, contrary to our expectation that the stylus maze might be particularly difficult for blind subjects due to their more infrequent use of the pencil or stylus as a working tool. In contrast to this generally superior performance of the blind as compared with the sighted, we find that each blind group includes some children who have more difficulty with the maze problems than almost any of the sighted children used.

In analyzing this situation, the mode of attack of the blind and sighted may in part explain their difference in success. The average number of errors summed in groups of five trials indicates an initial similarity in difficulty of the two mazes for the two groups. Evidently the difference in success is due to some other factor than original attack. In the stylus maze the blind make less errors than the sighted; in the finger maze it is the sighted who make the fewer. Here is an indication that there is a difference of adaptation of the blind and sighted to the tasks.

The time curve for the first 10 trials suggests that the blind may be dealing with situations to which they are more accustomed than are the sighted. The first few trials show the blind covering the path in less time, but after the fourth trial the sighted decrease their time to less than that taken by the blind. We might assume that this is due to the fact that the blind are dealing with something which is more familiar to them, and so they maintain a more even pace than the sighted, who after they become oriented increase their pace. The larger amount of time required for the finger pattern may be understood from a consideration of the situation. On the stylus maze, the groove tends to retain the stylus in the pattern, but on the finger maze, it is fairly easy for the finger to slip off the wire. On the stylus form, the hand experiences but little friction from contact with the pattern during movement, but the friction from movement on the finger pattern may become unpleasant if it is too strenuous. Thus the character of the situation tends to make the subject go through the high relief pattern more slowly than through the stylus pattern.

Analysis of the difficulties of culs-de-sac according to the number of times the single cul-de-sac is entered, the trial on which it is omitted, and the initial errors shows no particular difference between

the blind and sighted. Although greater difficulty is experienced with the stylus pattern, yet the ratio of difficulty between the various culs-de-sac remains fairly constant. The effect of sequences on the stylus maze seems to be about equal for the blind and sighted, but this effect on the blind when learning the finger pattern is less than on the sighted. The effect of sequences is decidedly more important in the case of the stylus maze than for the finger maze. Such a situation suggests that the attitude toward sequences may have a very definite effect upon maze-learning success.

The number of trials, errors, and time so correlate with each other that it may be assumed that they are approximately equal standards for comparison of maze-learning ability. In the case of the stylus maze, the continued negative correlation between the average time for each trial and the total number of trials required to learn, total errors, and time suggests that the subject who goes through the stylus maze slowly has a better chance for success in learning the pattern than the one who hurries through. This relation is not marked in the case of the finger maze.

Although the mean number of trials for the blind, grouped according to the degree of blindness, does not indicate a wholly consistent relation between the degree of blindness and maze-learning ability, the median does show the totally blind to be less successful than the partially blind, and the blind who have once possessed sight to be superior to either of the other two groups.

An examination of the learning methods used confirms the conclusions from earlier experiments that the verbal method of learning is the superior one. Half of the blind subjects use this method, while less than half of the sighted report using it. The blind probably find it more useful and natural to count off objects, steps, or turns than do individuals with unimpaired vision. This may account in part for the better success of the blind in these experiments.

The inability of S 16 to learn the stylus pattern after 300 trials arouses curiosity as to the cause of the situation. He was 14 years old with an I.Q. of 138. He did the experiment willingly, even giving up the larger portion of his lunch period one day when it was inconvenient to experiment during his study period. He was critically interested in the experiment, offering suggestions for improvement of the maze. Frequent, irrelevant, clever remarks indicated a scattered attention on the part of the subject. On the next to the last day when the subject was again requested to pay

attention to the maze problem, he said, "I don't see how anyone can pay attention to a thing which he can neither see nor feel." It is probable that, in the early part of the experiment, the subject conceived the impossibility of the situation and therefore failed to put forth much effort. A blind subject, B 2, 19 years old, I.Q. 103, at the end of about the 175th trial said, "Here at the Blind School we say, 'Keep on hoping,' " and he did eventually learn the pattern at the end of 260 trials. The expression "hoping" is a pretty sure indication of a lack of mental effort on the part of the subject. These two cases suggest that there is an important factor in the emotional attitude of the subject.

A comparison between our results and those found by Koch and Ufkess indicates the following agreements: (1) the degree of visual experience affects the maze-learning ability, that is, when subjects are considered as groups, those who have experienced vision have greater success than those who have been blind since birth; (2) intelligence and method of attack are elements which in part control the ability for maze learning; and (3) the groups of blind include more conspicuously poor maze learners than the groups of sighted. Koch and Ufkess reported the blind inferior to the sighted in maze learning, but they based their statements on averages. Their report is on 19 blind and for one maze. Consulting their Tables 3 and 4, we find that the median results are not far apart for their blind and sighted. Their blind show 9 trials, 52 errors, and 460 seconds, and their sighted give 10.5 trials, 25 errors, and 410 seconds. When we consider that in place of perfect blindfolding they used the canopy or screening method, which certainly gives the seeing subjects an advantage, it seems probable that their results are not out of harmony with our own. On the whole, we have the impression that blind subjects as a rule are as capable as the sighted in learning hand mazes. This is probably not true for those in whom the blindness is total and congenital.

It is reasonable to suppose that among the blind an emotional attitude unfavorable for attacking and accomplishing novel tasks is present more frequently than in ordinary groups of youths with full sight. This alone is sufficient to account for the higher incidence of the very unsuccessful. Not all have the calm objective judgment of a Francis Huber or the enthusiasm of Artman and Hall. Those who are dull and lacking in self-confidence extend the range of the scores and so exercise a strong influence on the averages for their

groups. The majority of the blind, that is of those ordinarily enrolled in our schools for the blind, when well motivated are probably not less capable when compared with those of equal intelligence on strictly non-visual tasks. Many of our blind subjects seemed to do actually better than the sighted chosen to match them. We have not stressed this. It may be in large part a difference in motivation. The experimenter was the same person throughout (Knotts), and every effort was made to treat blind and sighted exactly alike. However, the maze experiment may have been more of a novelty to the blind, and on the other hand the sighted (Palo Alto students rather frequently tested) may have been a little less keen for it. We say these are possibilities; we have no objective evidence that they were realities. However, they make us cautious about stressing the superiority of the performance by the blind.

Summary

1) The hand maze as an instrument for presenting spatial problems and studying learning has been very little used with the blind but seems admirably adapted for such use.

2) The high relief maze constructed as a narrow raised path to be traced directly by the finger is particularly well adapted for blind subjects.

3) In this study two mazes of identical pattern were used. One was made up of grooves and was to be traced with a stylus, and the other was a raised path to be traced by the finger. The pattern (after Warden) involved 10 culs-de-sac.

4) Two groups each containing 20 blind and two groups each containing 20 sighted were studied. Blind and sighted were carefully matched in chronological and mental age, and compared groups contained so many boys and so many girls. One group of blind and one of sighted (40 subjects in all) were used with each maze. The data for age, intelligence, and visual conditions are given.

5) The blind show median scores indicating somewhat better success than the sighted in number of trials, total errors, and total time for both mazes.

6) The blind show wider ranges of scores than the sighted; thus the blind groups include some who have more difficulty with the mazes than have any of the sighted. It is suggested that this may be due to an unfavorable emotional attitude.

7) The blind groups contained individuals who were more suc-

cessful than any of the sighted.

8) The raised maze traversed by the finger was found much easier for both blind and sighted than the similar stylus maze which did not afford direct cutaneous contact.

9) The stylus maze appeared about 20 per cent more difficult for the sighted than for the blind while, aside from the especially poor learners, the finger maze gave both groups about equal difficulty.

10) The learning curves are of the same character for both groups and for both mazes.

11) When the true path called for successive turns in one direction, errors were multiplied on the second and third members of such sequences. The blind show less of this expectation that the path will alternate right and left.

12) The intercorrelations of the scores for trials, errors, and time show coefficients ranging from .88 to .98 and appear equally high for both blind and sighted.

13) Mental age correlates (in some instances as high as .75) with success in maze learning, and it correlates more strongly than does chronological age.

14) The extent and duration of blindness influences the maze learning. The more successful learners among the blind tend to be those whose blindness is due to accident after the age of five years.

15) The verbal method of learning appears to be the most efficient, and it was found that a larger proportion of blind than of sighted employed the verbal method.

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L'HABILETÉ D'APPRENDRE LE LABYRINTHE CHEZ LES ENFANTS AVEUGLES ET LES ENFANTS VOYANTS

(Résumé)

Il semble que les expériences avec le labyrinthe à main soient bien adaptées à une comparaison des réponses des enfants aveugles et des voyants. On a employé deux labyrinthes de même forme. Les branches d'un labyrinthe ont été des couloirs à tracer avec le stylet, et celles de l'autre ont été des sentiers de haut relief en fil de fer à tracer directement avec le doigt. On a mis quarante aveugles, rangeant en âge chronologique de 14 à 20 ans, en paires avec 40 sujets voyants, 80 sujets en total. On a mis en paires les aveugles et les voyants sur la base des âges chronologiques et mentaux, et chaque paire a été du même sexe. On a bandé les yeux complètement à tous les sujets aveugles et voyants, et l'expérimentateur et les conditions ont été les mêmes pour tous les groupes. 20 aveugles et 20 voyants ont employé le labyrinthe à stylet, et les autres ont employé le labyrinthe de haut relief. Le labyrinthe a été de forme T, comprenant 10 culs-de-sac, et a été appris dans des épreuves consécutives pendant une séance. Les aveugles montrent des résultats du médian indiquant un peu plus de succès que les voyants pour le nombre des épreuves, les erreurs totales, et le temps total pour les deux labyrinthes. Les aveugles montrent une plus grande variation dans les résultats que les voyants. Le labyrinthe de haut relief a été plus facile pour les deux groupes que le labyrinthe à stylet. Les résultats des épreuves, des erreurs, et du temps ont une corrélation d'environ .95. L'âge mental et le succès ont une corrélation d'environ .70. Ceux qui ont mieux réussi à l'apprentissage étaient devenus aveugles par accident et ont employé une méthode verbale.

Knotts et Miles

DIE FÄHIGKEIT BLINDER KINDER EIN LABYRINTH ZU ERLERNEN IM VERGLEICH MIT SEHENDEN KINDERN

(Referat)

Experimente mit dem "Hand maze" oder Labyrinth scheinen besonders geeignet die Reaktion blinder Kinder mit derjenigen von sehenden zu

vergleichen. Man benutzte zwei Apparate desselben Musters. An dem einen waren Rinnen angebracht die mit einem Stift verfolgt werden konnten, an dem andern war das Muster erhaben mit Draht angebracht, so dass es mit dem Finger verfolgt werden konnte. Vierzig blinde, im Alter von 14 bis 20 Jahren wurden mit 40 sehenden Versuchspersonen gepaart, im ganzen 80 Vpn. Sehende und Blinde wurden je nach ihrem Lebensalter und Intelligenzalter gepaart, und jedes Paar war vom selben Geschlecht. Zwanzig Blinde und 20 Sehende benutzten denselben Apparat, "stylus maze," und die übrigen Vpn. den Apparat mit der erhabenen Bahn. Allen Vpn., den blinden so wie den sehenden, wurden die Augen verbunden, und der Versuchsleiter und alle Umstände waren für alle Gruppen dieselben. Das Labyrinth hatte die T-form und enthielt 10 culs-de-sac, und wurde bei auf einander folgenden Versuchen in einer Sitzung gelernt. Die Wertleistungen der Blinden erwiesen im Durchschnitt einen etwas bessern Erfolg als die der Sehenden für die Anzahl von Versuchen, in Totalfehlern und im Totalzeitraum, bei beiden Apparaten. Die Blinden zeigten eine etwas grössere Verschiedenheit der Wertleistungen als die Sehenden. Das Labyrinth mit erhabener Bahn war für beide Gruppen leichter. Wertleistungen der Versuche, Fehlleistungen und Zeitdauer korrelieren ungefähr .95. Das Intelligenzalter korreliert mit dem Erfolg ungfähr .70. Die Tüchtigsten unter den Versuchspersonen waren durch Unfall erblindet und benutzten eine Wortmethode.

KNOTTS UND MILES

СРАВНИТЕЛЬНАЯ СПОСОБНОСТЬ СЛЕПЫХ И ЗРЯЧИХ ДЕТЕЙ РАЗБИРАТЬСЯ В ЛАБИРИНТЕ.

(Реферат).

Ручной лабиринт хорошо приспособлен для сравнения реакций слепых и зрячих детей. В данной работе были использованы два лабиринта одинакового образца. В одном из них путями служили жёлобки, которые можно было прослеживать, прикасаясь к ним иглой, в другом—были сделаны рельефные дорожки из проволоки, которые можно было прослеживать непосредственно прикосновеннем пальца.

Сорок слепых в возрасте от 14 до 20 лет были попарно распределены с 40 зрячими (всего—80 человек). Слепые и зрячие были расположены по возрасту и интеллектуальному уровню, причем пары были одного пола. Всем испытуемым, слепым и зрячим, были завязаны глаза; во все время опыта присутствовал один и тот же экспериментатор, и условия опыта были все время одинаковые. 20 слепых и 20 зрячих пользовались лабиринтом с иглой, остальные же—проволочным лабиринтом. Лабиринт был в виде быквы Т и содержал 10 тупиков. Пути лабиринта были изучены во время одного опыта при последовательных повторениях. Слепые дали несколько лучшие результаты в отношение количества повторений, общего числа ошибок и затраченного на изучение времени. У слепых наблюдались бо́льшие колебания в результатах, чем у зрячих. Обоим группам испытуемых легче было ориентироваться в проволочном лабиринте, чем в лабиринте с желобками. Корреляция повторений, ошибок и времени равна . 95. Умственный уровень дает с успешностью корреляцию в . 70. Лучшие результаты оказались у ослепших в результате несчастных случаев и которые, как оказалось—пользовались речевым методом.

Нотс и Майлс (Knotts and Miles).

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